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"Reconcile land system changes
with planetary health"

Multi-criteria land use decision (MCLUD): A framework to guide land use planning using the AHP model

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Abstract

Planetary boundaries, land use system changes, and climate change are intrinsically interconnected and all contribute to the broader concept of planetary health. To safeguard the planetary boundary related to land system change, Forest Landscape Restoration (FLR) is being implemented on a global scale. However, in the implementation process, restoring ecological functions, such as mitigating land degradation, reducing soil erosion, and sequestering carbon, receives more attention than enhancing the local community's well-being. Therefore, it is essential to consider various factors that influence land use decisions to adopt a holistic approach to land use decisions. The objective of this study is to develop a multi-stakeholder land-use decision support framework that integrates environmental, social, and economic dimensions to inform land-use planning decision-making processes. To achieve this objective, the Analytical Hierarchy Process (AHP) model, a multi-criteria decision-making (MCDM) method, is applied. This model facilitates the decision-making process for decision-makers facing complex problems with multiple conflicting and subjective criteria. We organised four workshops with different stakeholders, including farmers and experts from woreda, zonal, and federal levels. In the workshops, land use decision factors at the indicator and sub-indicator levels were developed, and a ranking of these decision factors was applied using the AHP matrix. Results show that a higher degree of consistency is achieved in the matrix with a Consistency Ratio (CR) of 0.01, as determined by federal-level experts. A tolerable CR of 0.01 is also achieved with farmers' criteria ranking. Different stakeholders have varying priorities, but overall, climatic, economic, and environmental factors are among the top three, showing high priority weights above 0.4. A sensitivity analysis of the priority weights is conducted, and sensitive factors are identified, which are then used to develop a decision support tree for land use factor prioritisation. The decision tree highlights seven critical sub-factors that hold a priority weight above 0.4 and are sensitive at the threshold level of 0.01. Selecting well-defined and compelling indicators will help align stakeholder perspectives and foster consensus in decision-making that ultimately contributes to planetary health.

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